What Is Claimed Is:

1. A method for bounding the solution set of a system of linear equations $\mathbf{Ax} = \mathbf{b}$, wherein $\mathbf{A}$ is an interval matrix and $\mathbf{b}$ is an interval vector, the method comprising:

preconditioning the set of linear equations $\mathbf{Ax} = \mathbf{b}$ by multiplying through by a matrix $\mathbf{B}$ to produce a preconditioned set of linear equations $\mathbf{M}_0\mathbf{x} = \mathbf{r}$, wherein $\mathbf{M}_0 = \mathbf{BA}$ and $\mathbf{r} = \mathbf{Bb}$;

widening the matrix $\mathbf{M}_0$ to produce a widened matrix $\mathbf{M}$, wherein the midpoints of the elements of $\mathbf{M}$ form the identity matrix; and

using $\mathbf{M}$ and $\mathbf{r}$ to compute the hull $\mathbf{h}$ of the system $\mathbf{Mx} = \mathbf{r}$, which bounds the solution set of the system $\mathbf{M}_0\mathbf{x} = \mathbf{r}$.

2. The method of claim 1, wherein the method further comprises computing the matrix $\mathbf{B}$ by:

computing an approximate center $\mathbf{A}_C$ of the matrix $\mathbf{A}$; and

forming $\mathbf{B}$ by computing an approximate inverse of $\mathbf{A}_C$, $\mathbf{B} = (\mathbf{A}_C)^{-1}$.

3. The method of claim 1, wherein using $\mathbf{M}$ and $\mathbf{r}$ to compute the hull $\mathbf{h}$ involves:

forming $\mathbf{P}$ as an inverse of the left endpoint of $\mathbf{M}$;

forming $c_i = 1/(2P_{ii} - 1)$ for $i = 1, \ldots, n$;

forming $z_i = (inf(r_i)+sup(r_i))P_{ii} - e_i^T\mathbf{P}sup(\mathbf{r})$, wherein e_i^T is a unit vector in which the i-th element is 1 and other elements are 0;

setting $inf(h_i) = c_i z_i$ if $z_i > 0$;

setting $inf(h_i) = z_i$ if $z_i \leq 0$; and

setting $sup(\mathbf{h}) = \mathbf{P}sup(\mathbf{r})$.

4. The method of claim 1, further comprising assuring that $sup(r_i) \geq 0$ by changing the sign of r_i (and x_i) if necessary.

5. The method of claim 1, further comprising:

determining if **M** is regular; and

using the Gauss-Seidel process for computing the hull **h** if **M** is not regular.

6. A computer-readable storage medium storing instructions that when executed by a computer cause the computer to perform a method for bounding the solution set of a system of linear equations $\mathbf{Ax} = \mathbf{b}$, wherein **A** is an interval matrix and **b** is an interval vector, the method comprising:

preconditioning the set of linear equations $\mathbf{Ax} = \mathbf{b}$ by multiplying through by a matrix **B** to produce a preconditioned set of linear equations $\mathbf{M_0x} = \mathbf{r}$, wherein $\mathbf{M_0} = \mathbf{BA}$ and $\mathbf{r} = \mathbf{Bb}$;

widening the matrix $\mathbf{M_0}$ to produce a widened matrix **M**, wherein the midpoints of the elements of **M** form the identity matrix; and

using **M** and **r** to compute the hull **h** of the system $\mathbf{Mx} = \mathbf{r}$, which bounds the solution set of the system $\mathbf{M_0x} = \mathbf{r}$.

7. The computer-readable storage medium of claim 6, wherein the method further comprises computing the matrix **B** by:

computing an approximate center $\mathbf{A_C}$ of the matrix **A**; and

forming **B** by computing an approximate inverse of $\mathbf{A_C}$, $\mathbf{B} = (\mathbf{A_C})^{-1}$.

8. The computer-readable storage medium of claim 6, wherein using **M** and **r** to compute the hull **h** involves:

forming **P** as an inverse of the left endpoint of **M**;

forming $c_i = 1/(2P_{ii} - 1)$ for $i = 1, \ldots, n$;

forming $z_i = (inf(r_i)+sup(r_i))P_{ii} - e_i^T\mathbf{P}sup(\mathbf{r})$, wherein e_i^T is a unit vector in which the i-th element is 1 and other elements are 0;

setting $inf(h_i) = c_i z_i$ if $z_i > 0$;

setting $inf(h_i) = z_i$ if $z_i \le 0$; and

setting $sup(\mathbf{h}) = \mathbf{P}sup(\mathbf{r})$.

9. The computer-readable storage medium of claim 6, wherein the method further comprises assuring that $sup(r_i) \ge 0$ by changing the sign of r_i (and x_i) if necessary.

10. The computer-readable storage medium of claim 6, wherein the method further comprises:

determining if **M** is regular; and

using the Gauss-Seidel process for computing the hull **h** if **M** is not regular.

11. An apparatus that bounds the solution set of a system of linear equations **Ax** = **b**, wherein **A** is an interval matrix and **b** is an interval vector, comprising:

a preconditioning mechanism that is configured to precondition the set of linear equations **Ax** = **b** by multiplying through by a matrix **B** to produce a preconditioned set of linear equations $\mathbf{M}_0\mathbf{x} = \mathbf{r}$, wherein $\mathbf{M}_0 = \mathbf{BA}$ and $\mathbf{r} = \mathbf{Bb}$;

a widening mechanism that is configured to widen the matrix $\mathbf{M}_0$ to produce a widened matrix $\mathbf{M}$, wherein the midpoints of the elements of $\mathbf{M}$ form the identity matrix; and

a hull computing mechanism that is configured to use $\mathbf{M}$ and $\mathbf{r}$ to compute the hull $\mathbf{h}$ of the system $\mathbf{Mx} = \mathbf{r}$, which bounds the solution set of the system $\mathbf{M}_0\mathbf{x} = \mathbf{r}$.

12. The apparatus of claim 11, wherein the preconditioning mechanism is configured to:

compute an approximate center $\mathbf{A}_C$ of the matrix $\mathbf{A}$; and to

form $\mathbf{B}$ by computing an approximate inverse of $\mathbf{A}_C$, $\mathbf{B} = (\mathbf{A}_C)^{-1}$.

13. The apparatus of claim 11, wherein the hull computing mechanism is configured to:

form $\mathbf{P}$ as an inverse of the left endpoint of $\mathbf{M}$;

form $c_i = 1/(2P_{ii} - 1)$ for $i = 1, \ldots, n$;

form $z_i = (inf(r_i)+sup(r_i))P_{ii} - e_i^T\mathbf{P}sup(\mathbf{r})$, wherein e_i^T is a unit vector in which the i-th element is 1 and other elements are 0;

set $inf(h_i) = c_i z_i$ if $z_i > 0$;

set $inf(h_i) = z_i$ if $z_i \leq 0$; and to

set $sup(\mathbf{h}) = \mathbf{P}sup(\mathbf{r})$.

14. The apparatus of claim 11, wherein the preconditioning mechanism is configured to assure that $sup(r_i) \geq 0$ by changing the sign of r_i (and x_i) if necessary.

15. The apparatus of claim 11, wherein the preconditioning mechanism is configured to:

determine if **M** is regular; and to

terminate the process of computing the hull **h** if **M** is not regular.

16. A method for bounding the solution set of a system of linear equations $\mathbf{Ax} = \mathbf{b}$ by multiplying through by the matrix **B** to produce a preconditioned set of linear equations $\mathbf{M}_0\mathbf{x} = \mathbf{r}$, wherein $\mathbf{M}_0 = \mathbf{BA}$ and $\mathbf{r} = \mathbf{Bb}$, the method comprising:

assuring that $sup(r_i) \geq 0$ by changing the sign of r_i (and x_i) if necessary;

widening the matrix $\mathbf{M}_0$ to produce a widened matrix **M**, wherein the midpoints of the elements of **M** form the identity matrix; and

using **M** and **r** to compute the hull **h** of the system $\mathbf{Mx} = \mathbf{r}$, which bounds the solution set of the system $\mathbf{M}_0\mathbf{x} = \mathbf{r}$ by,

forming **P** as an inverse of the left endpoint of **M**,

forming $c_i = 1/(2P_{ii} - 1)$ for $i = 1, \ldots, n$,

forming $z_i = (inf(r_i)+sup(r_i))P_{ii} - e_i^T\mathbf{P}sup(\mathbf{r})$, wherein e_i^T is a unit vector in which the i-th element is 1 and other elements are 0,

setting $inf(h_i) = c_i z_i$ if $z_i > 0$,

setting $inf(h_i) = z_i$ if $z_i \leq 0$, and

setting $sup(\mathbf{h}) = \mathbf{P}sup(\mathbf{r})$.

17. The method of claim 16, further comprising:

determining if **M** is regular; and

using the Gauss-Seidel process for computing the hull **h** if **M** is not regular.

18. The method of claim 16, wherein the method further comprises computing the matrix **B** by:

computing an approximate center $\mathbf{A}_C$ of the matrix **A**; and

forming **B** by computing an approximate inverse of $\mathbf{A}_C$, $\mathbf{B} = (\mathbf{A}_C)^{-1}$.